US008556397B2

(12) **United States Patent**
Rittgers et al.

(10) **Patent No.: US 8,556,397 B2**
(45) **Date of Patent: Oct. 15, 2013**

(54) **INK CONTAINER TO SEPARATE UNWANTED PARTICLES FROM INK**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 126 days.

(21) Appl. No.: **13/259,690**

(22) PCT Filed: **Dec. 15, 2009**

(86) PCT No.: **PCT/US2009/068074**

§ 371 (c)(1),
(2), (4) Date: **Sep. 23, 2011**

(87) PCT Pub. No.: **WO2011/075118**

PCT Pub. Date: **Jun. 23, 2011**

(65) **Prior Publication Data**

US 2012/0013688 A1 Jan. 19, 2012

(51) **Int. Cl.**
B41J 2/175 (2006.01)
B41J 2/17 (2006.01)

(52) **U.S. Cl.**
USPC **347/86**; 347/84; 347/93

(58) **Field of Classification Search**
USPC 347/84, 85, 86, 93
See application file for complete search history.

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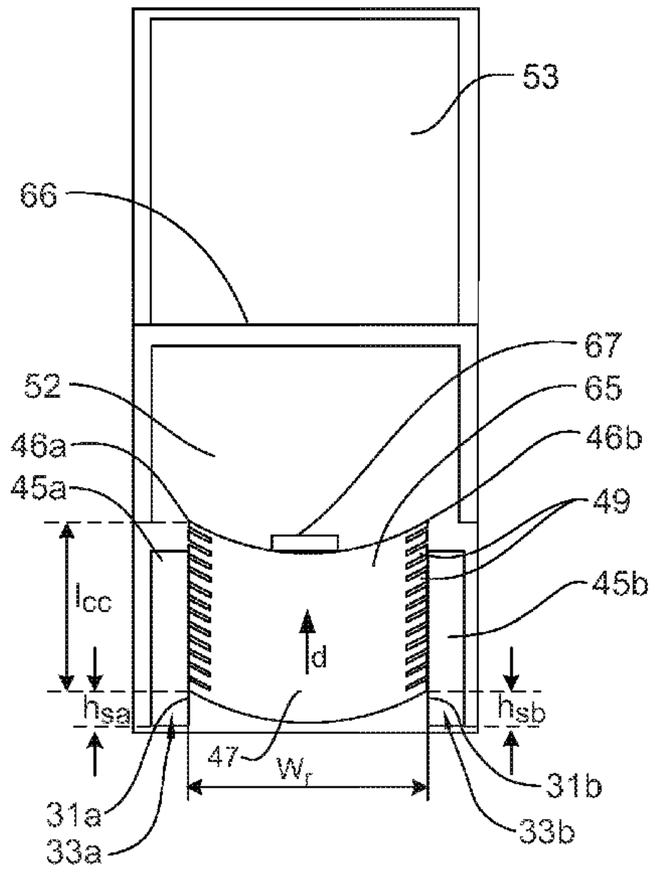
(57) **ABSTRACT**

An ink container usable with an image forming apparatus having a carriage to transport the ink container in a reciprocating motion across a substrate and an ink ejector to eject the ink onto the substrate is included. The ink container includes a chamber configured to supply ink to the ink ejector of the image forming apparatus. The ink container also includes a separation member disposed within the chamber configured to separate unwanted particles from the ink in response to the reciprocating motion of the carriage and gravity, and to direct the ink downstream to the ink ejector.

14 Claims, 8 Drawing Sheets



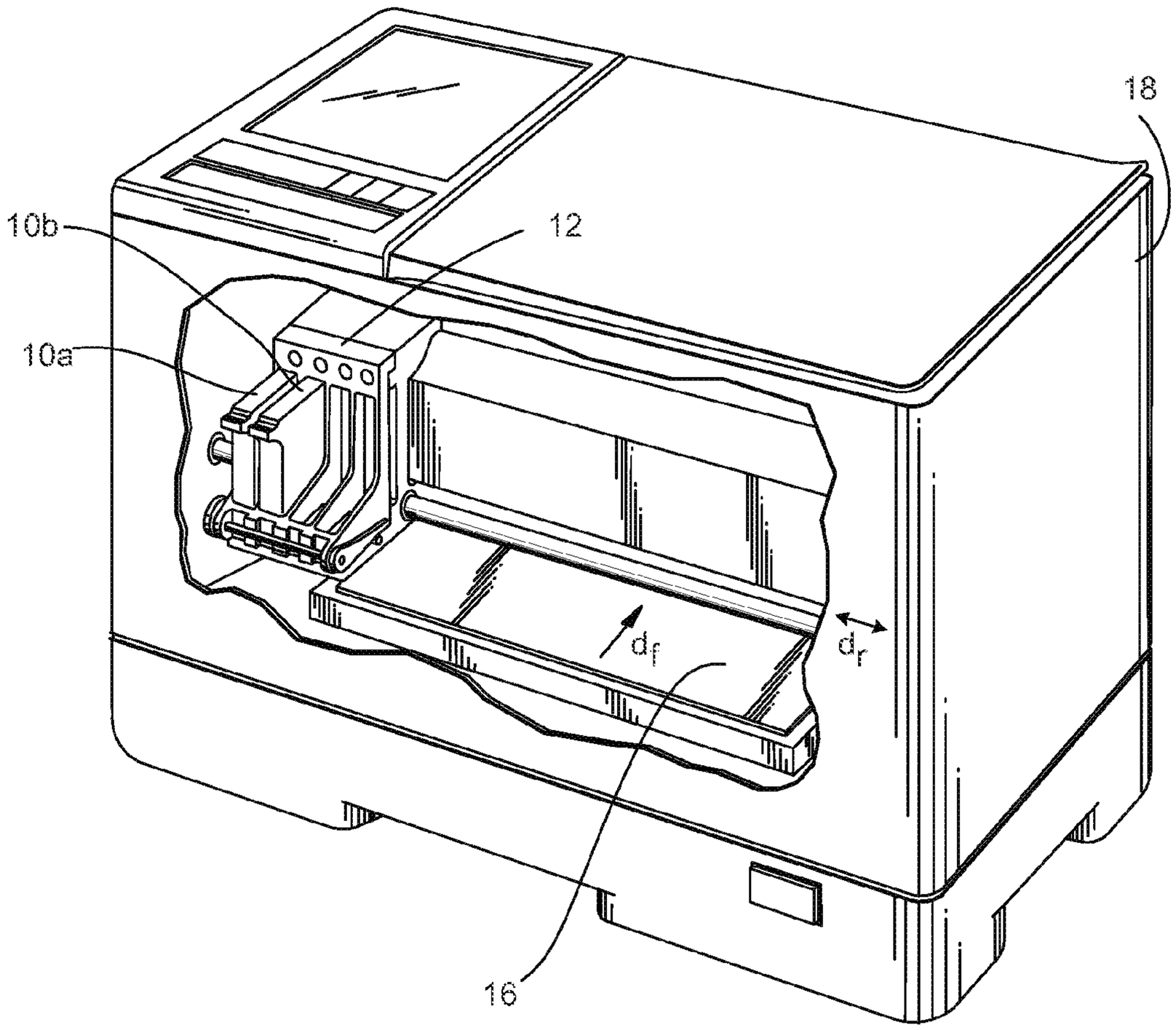


Fig. 1

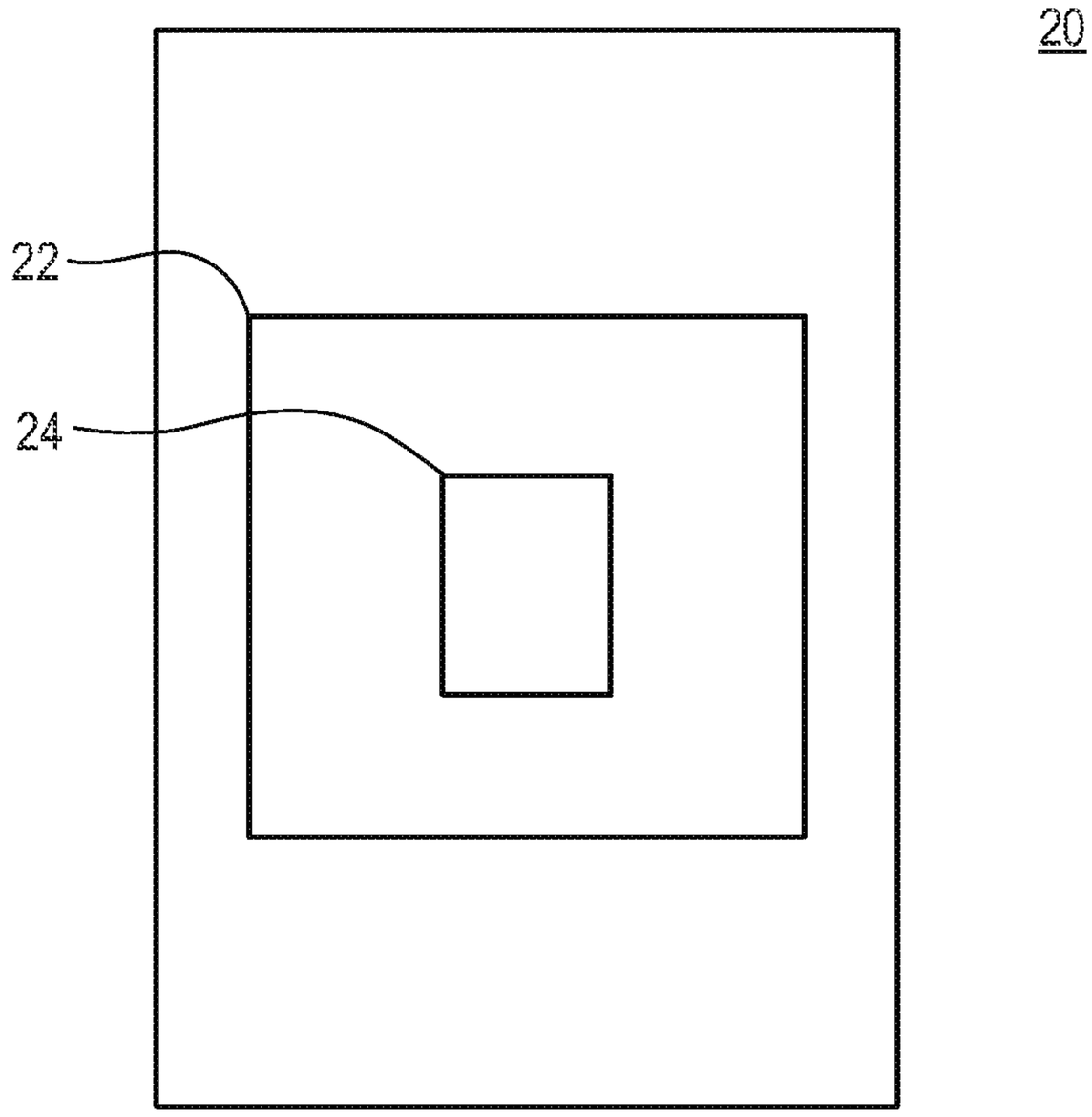


Fig. 2

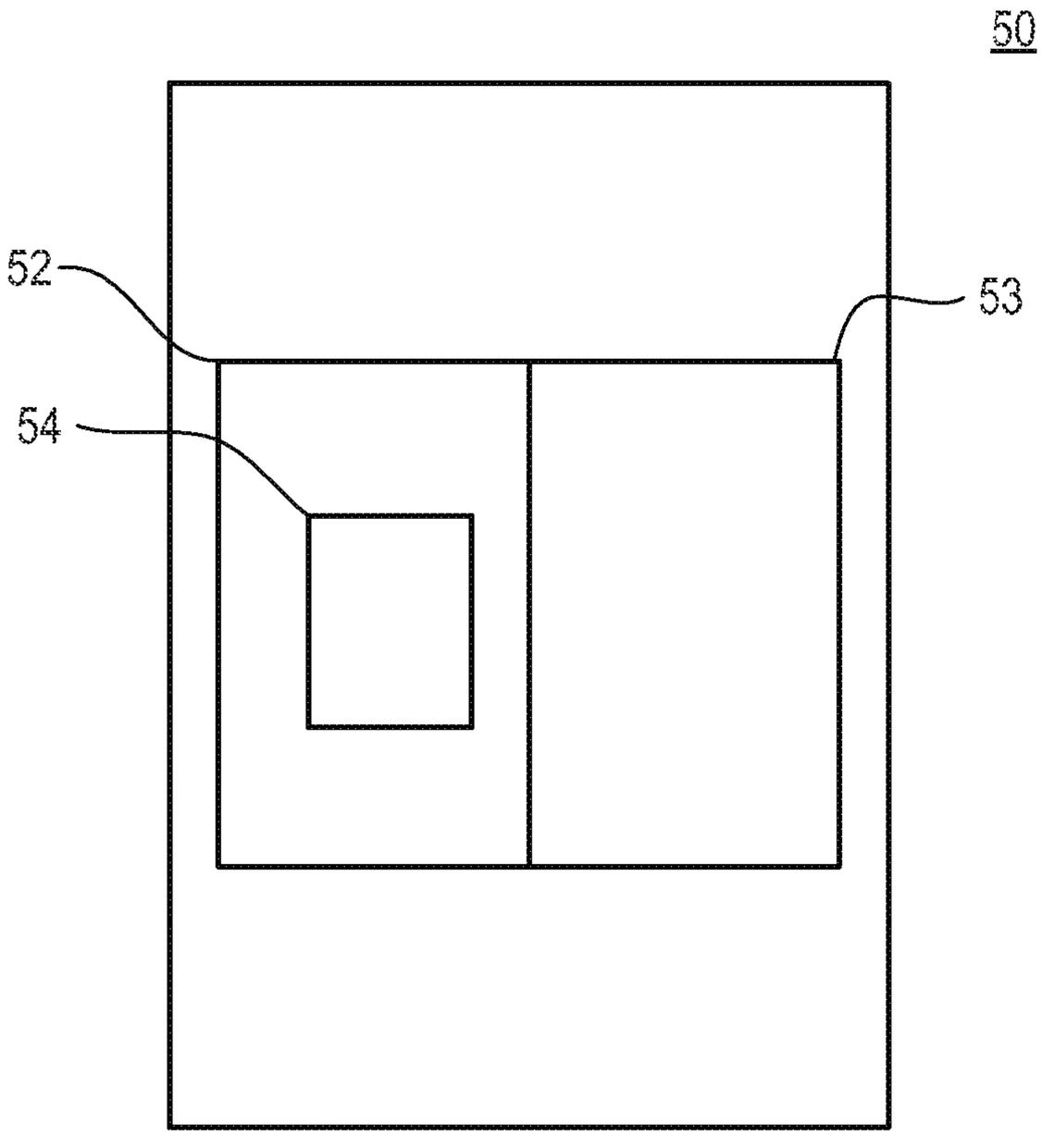


Fig. 5

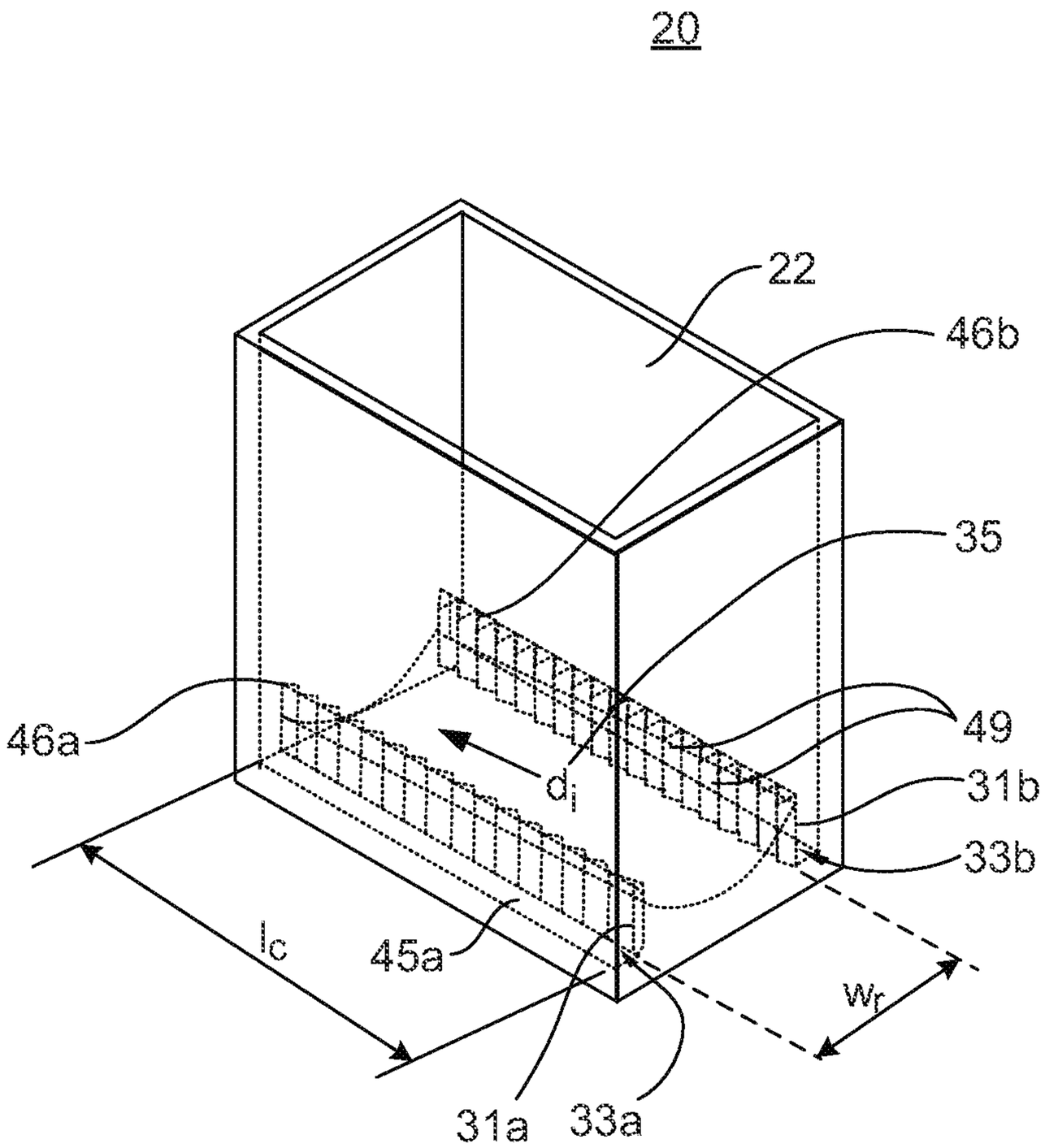


Fig. 3

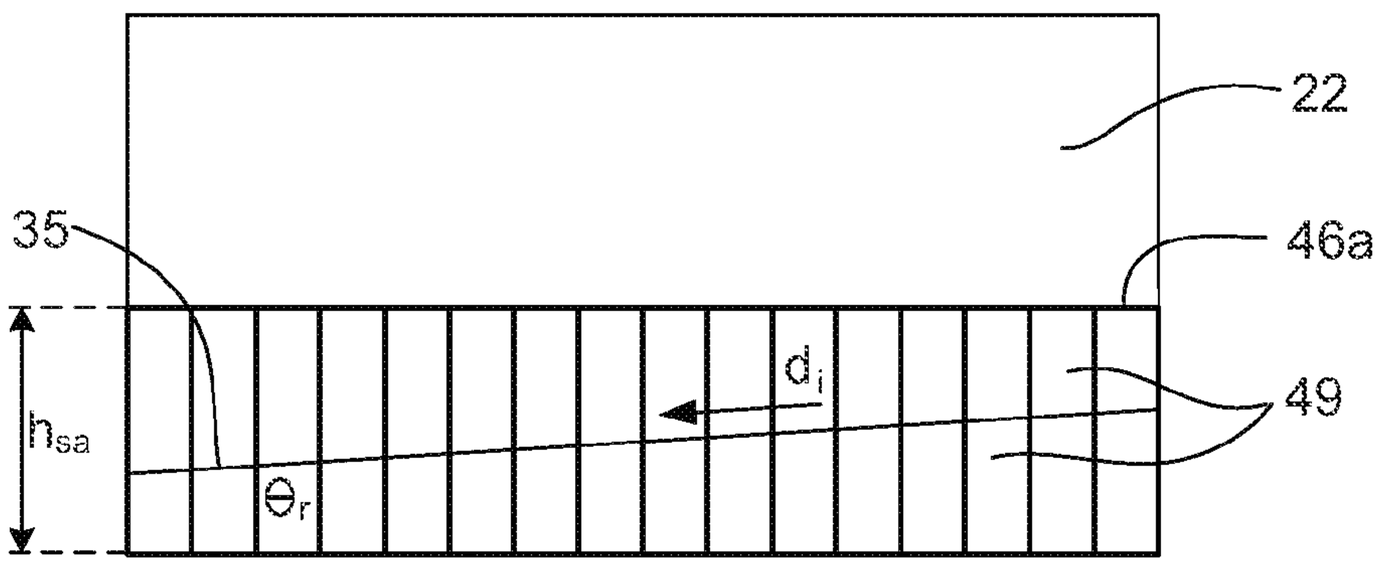


Fig. 4A

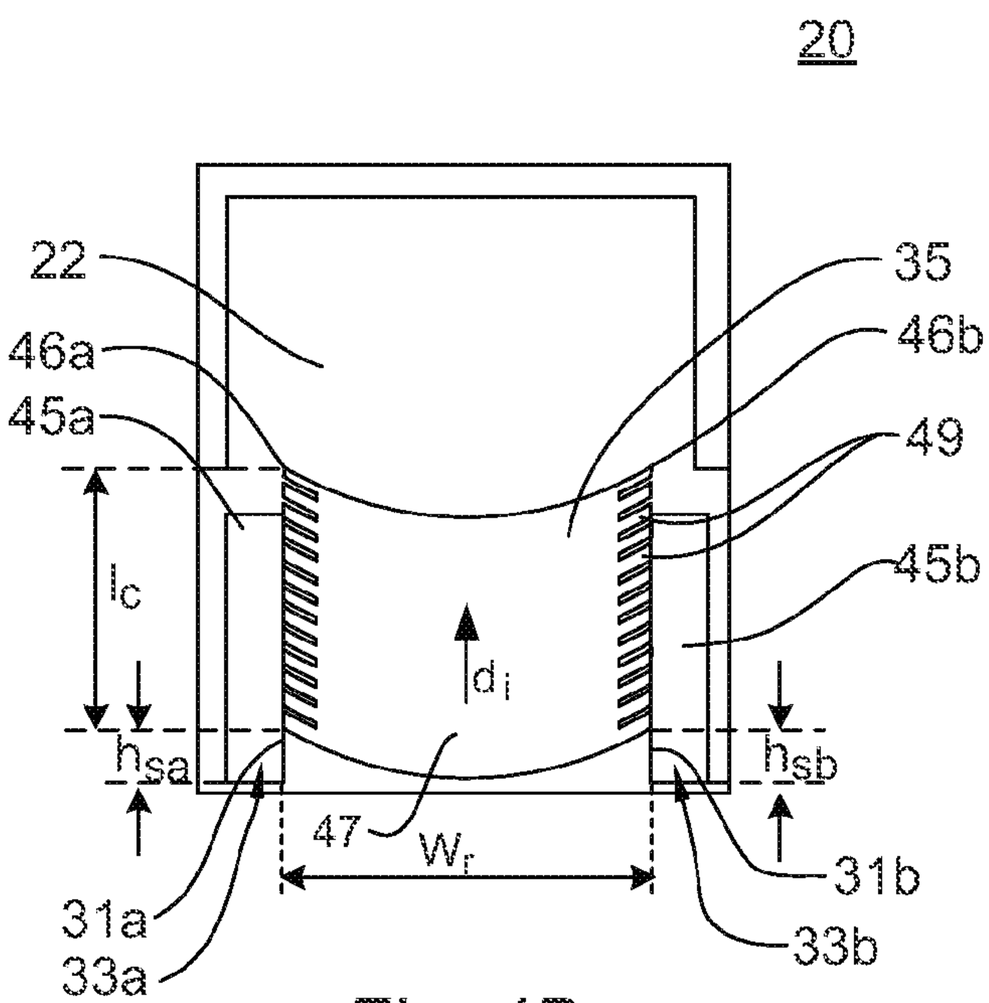


Fig. 4B

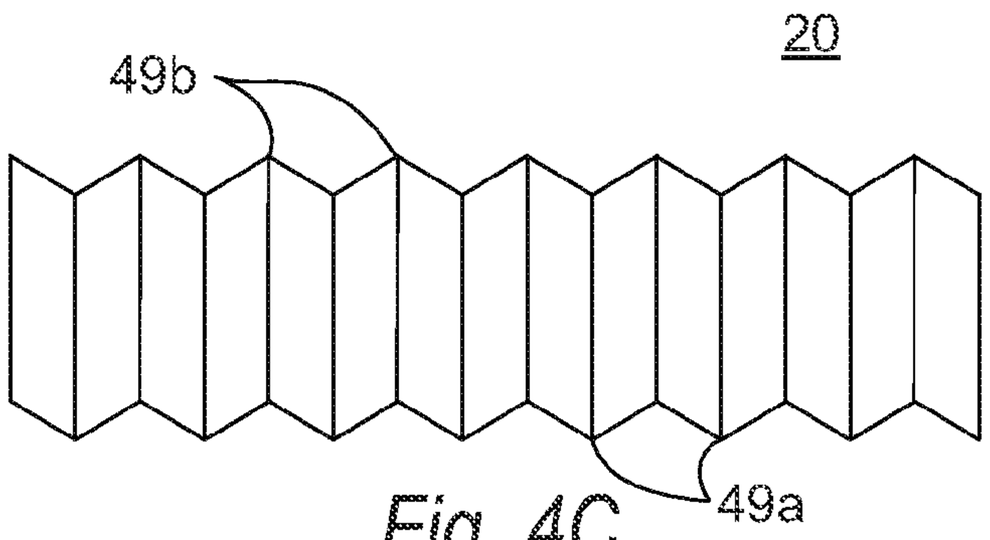


Fig. 4C

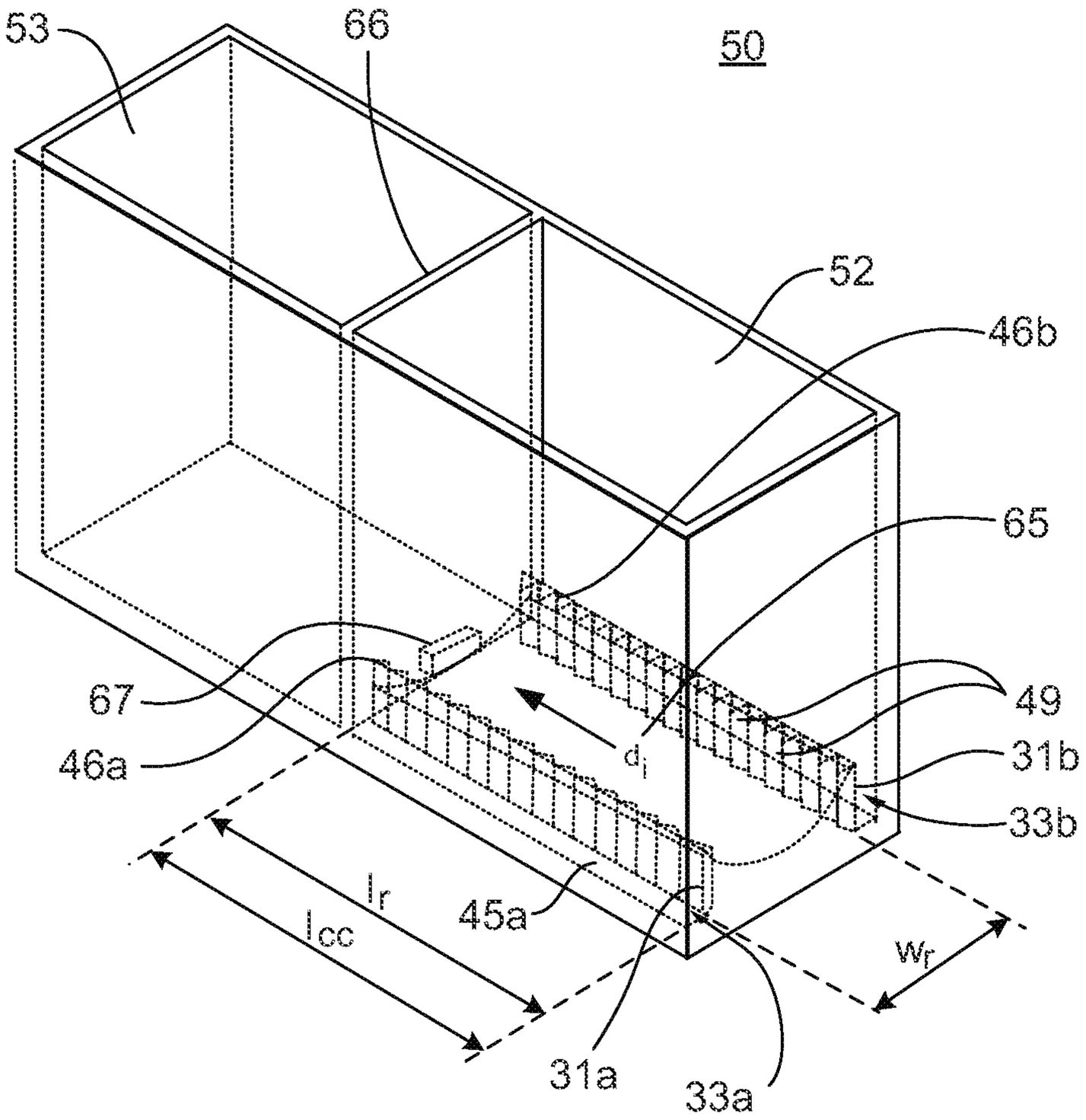


Fig. 6

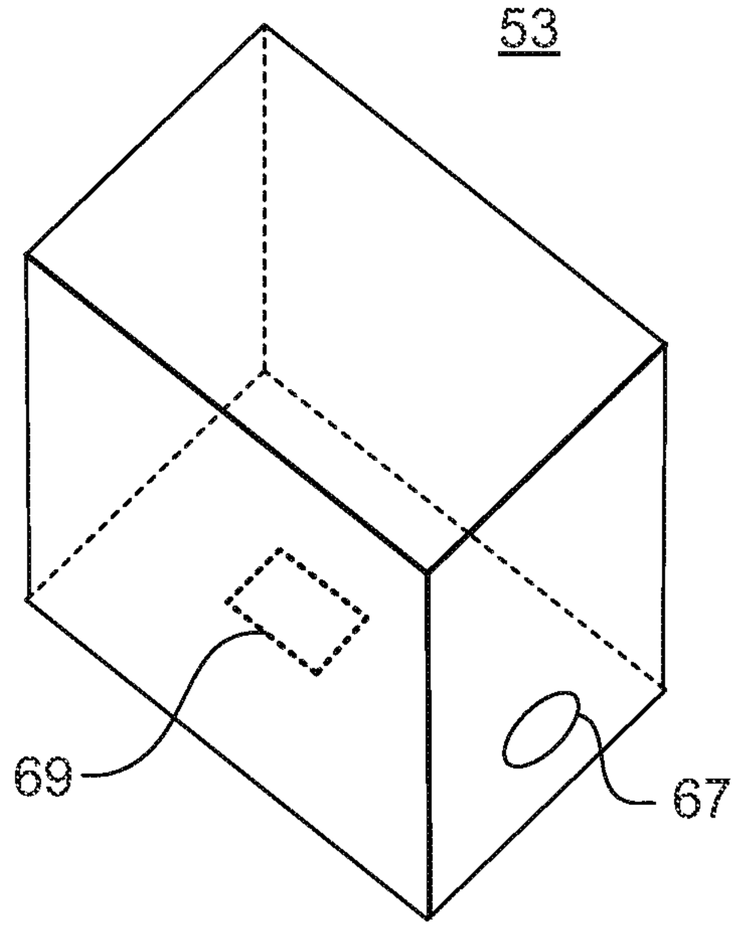


Fig. 7A

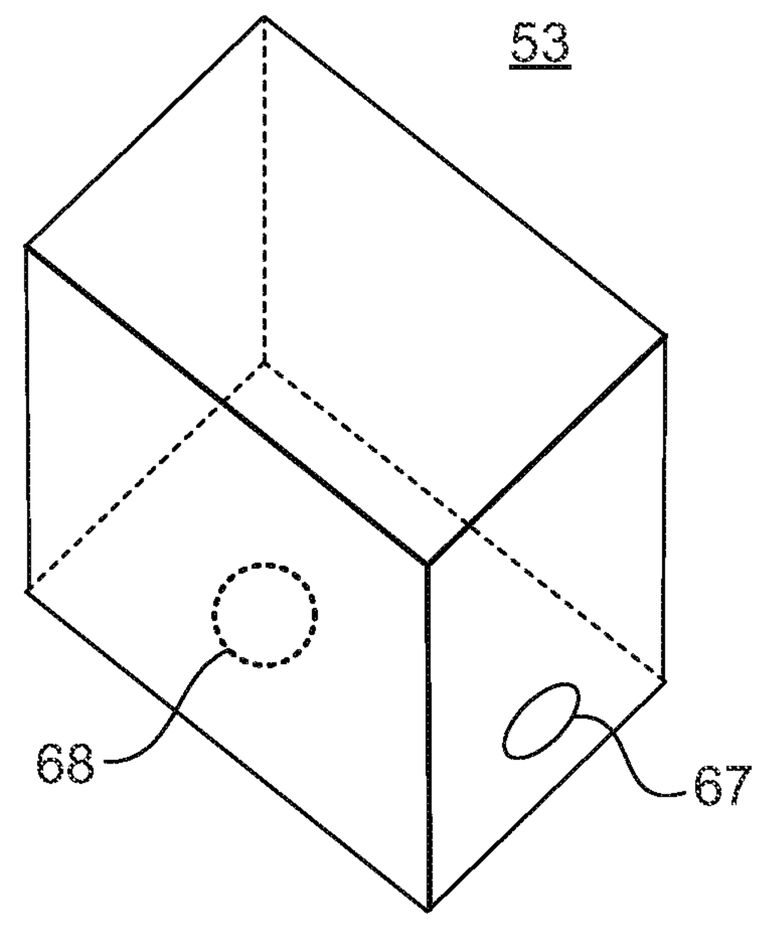
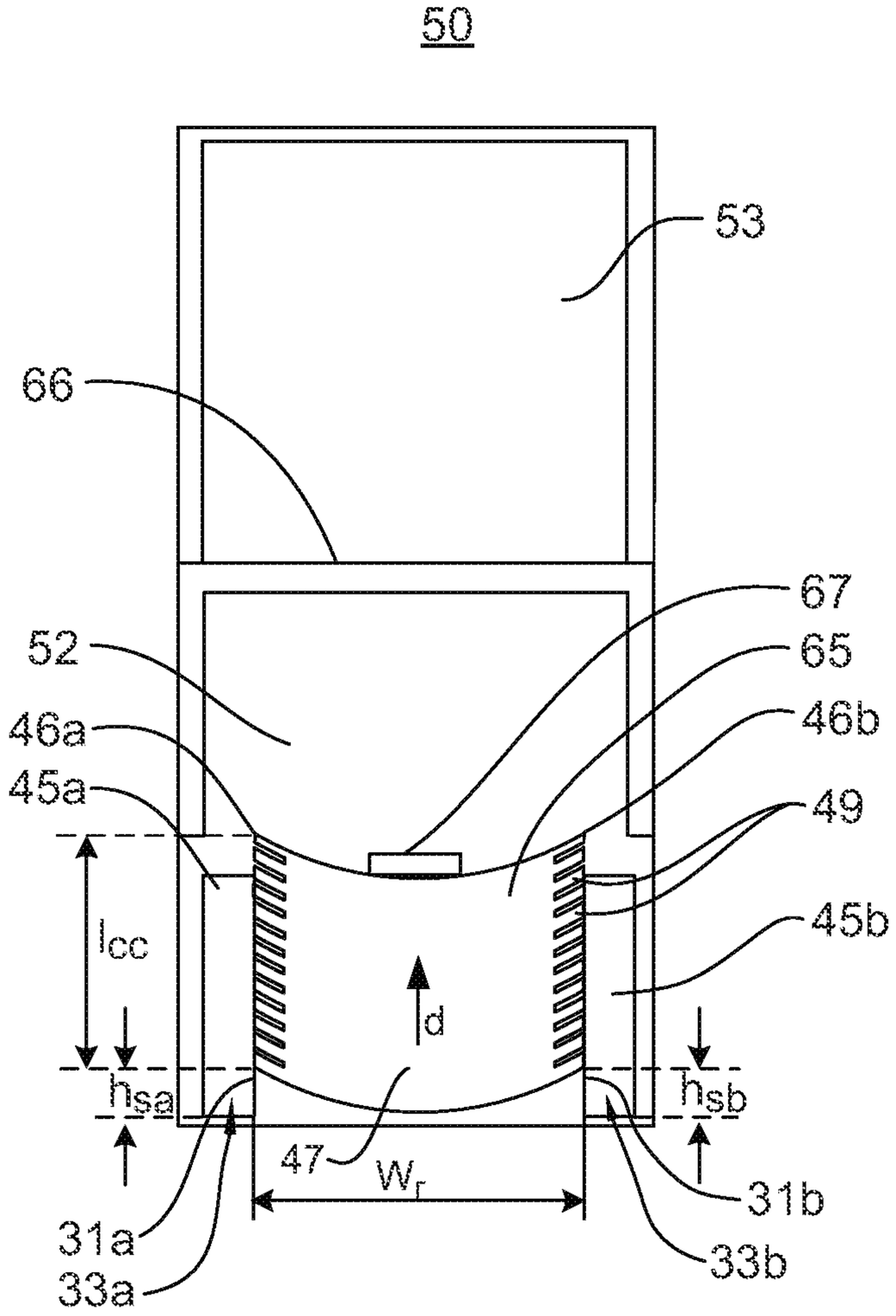


Fig. 7B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53
66
67
52
65
46a
46b
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49
45b
lcc
d
hsa
hsb
47
Wr
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31b
33a
33b

Fig. 8

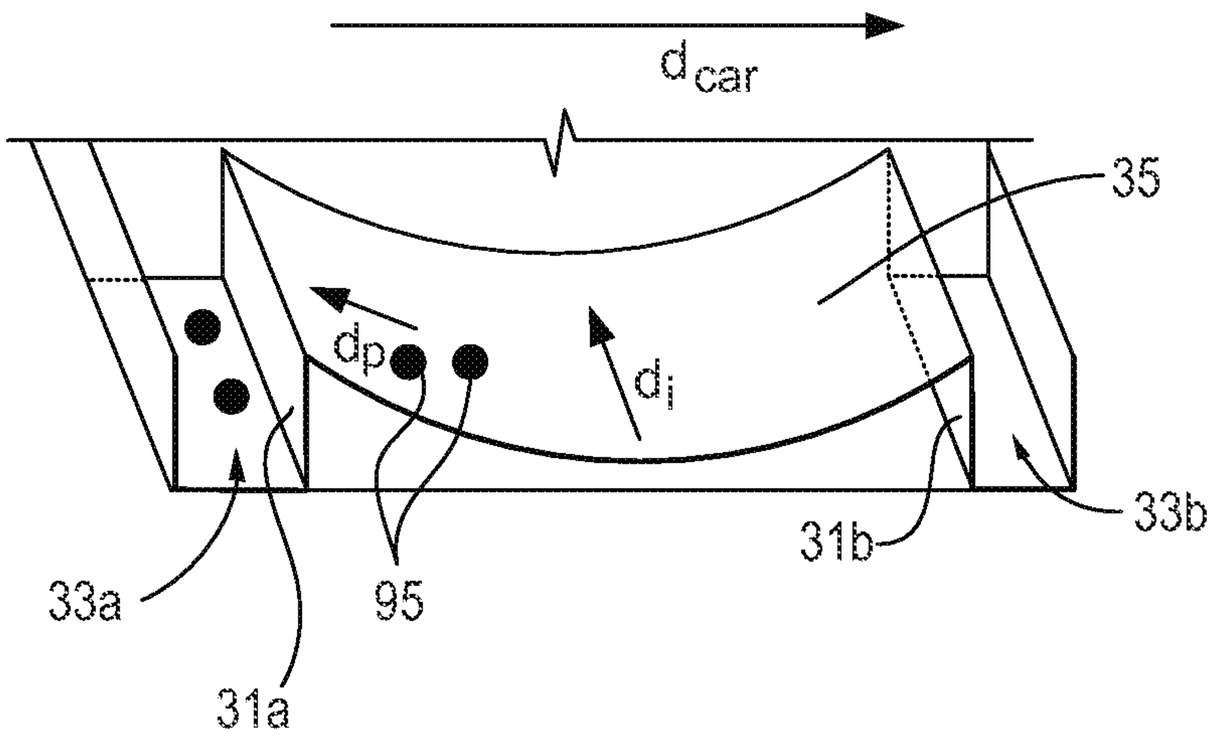

Fig. 9A

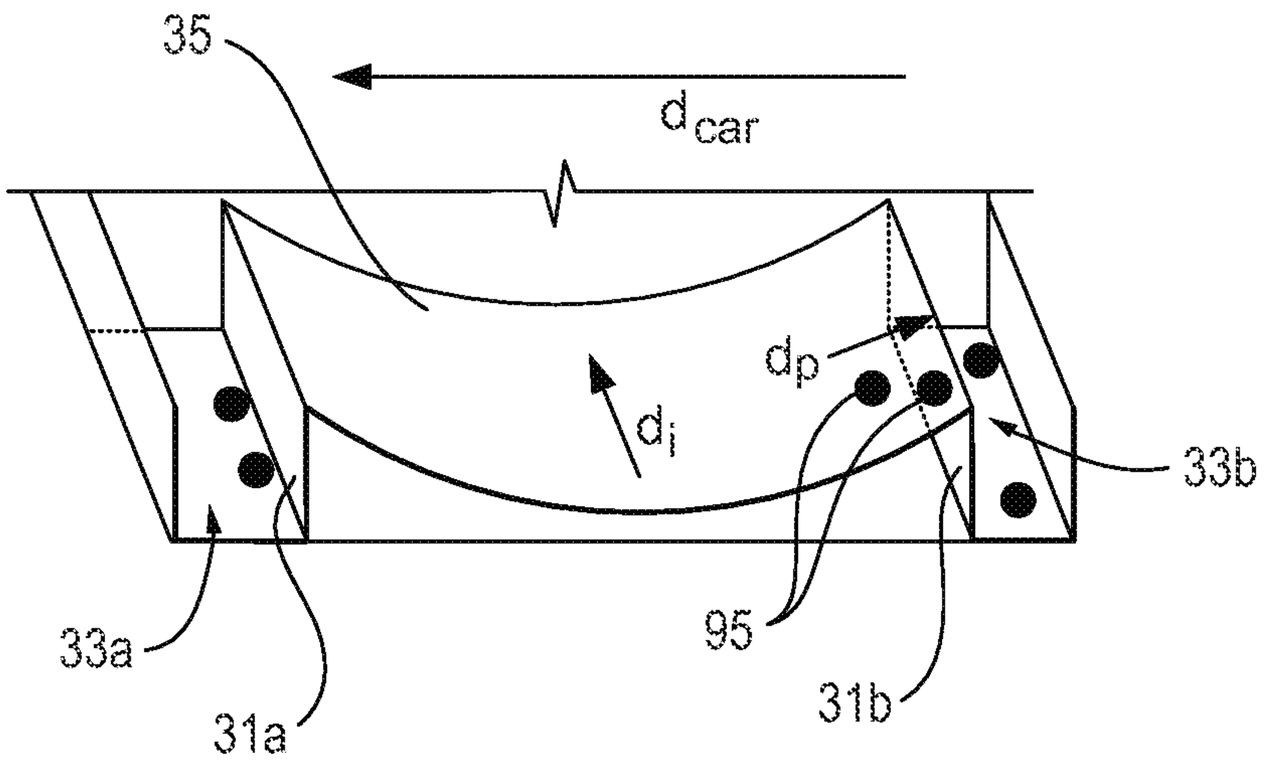

Fig. 9B

INK CONTAINER TO SEPARATE UNWANTED PARTICLES FROM INK

BACKGROUND

Ink containers are used to supply ink to image forming apparatus. Ink containers may be removably attached to a carriage of the image forming apparatus to move back and forth across a substrate for the ink to be ejected on. A plurality of removable ink containers may be included on the carriage in which each ink container may contain ink of a different color such as black, magenta, cyan and yellow. Some ink containers may supply ink to an ink ejector to eject the ink onto the substrate in which the ink ejector is separate from the ink container. Other ink containers may supply ink to an ink ejector which is integrated with the ink containers.

BRIEF DESCRIPTION OF THE DRAWINGS

Example non-limiting embodiments of the present general inventive concept are described in the following description, read with reference to the figures attached hereto and do not limit the scope of the claims. In the figures, identical and similar structures, elements or parts thereof that appear in more than one figure are generally labeled with the same or similar references in the figures in which they appear. Dimensions of components and features illustrated in the figures are chosen primarily for convenience and clarity of presentation and are not necessarily to scale. Referring to the attached figures:

FIG. **1** is a perspective view with a cutout partially illustrating ink containers mounted on a carriage of an image forming apparatus according to an example embodiment of the present general inventive concept.

FIG. **2** is a block diagram illustrating an ink container according to an example embodiment of the present general inventive concept.

FIG. **3** is a perspective view illustrating the ink container of FIG. **2** according to an example embodiment of the present general inventive concept.

FIG. **4**A is a side view of the ink container of FIG. **3** illustrating an inclined ramp portion of a separation member according to an example embodiment of the present general inventive concept.

FIG. **4**B is a top perspective view illustrating the ramp portion of FIG. **3** according to an example embodiment of the present general inventive concept.

FIG. **4**C is a cross-sectional view of a side wall of a separation member according to an example embodiment of the present general inventive concept.

FIG. **5** is a block diagram of an ink container according to an example embodiment of the present general inventive concept.

FIG. **6** is a perspective view illustrating the ink container of FIG. **5** according to an example embodiment of the present general inventive concept.

FIGS. **7**A and **7**B are top perspective views of other chamber of the ink container of FIG. **6** including an ink ejector and a hole, respectively, according to example embodiments of the present general inventive concept.

FIG. **8** is a top perspective view illustrating a ramp portion of FIG. **6** according to an example embodiment of the present general inventive concept.

FIGS. **9**A and **9**B are top perspective views illustrating a portion of ink container and movement of the ink and unwanted particles in response to carriage motion according to example embodiments of the present general inventive concept.

Throughout the drawings, identical reference numbers designate similar, but not necessarily identical, elements.

DETAILED DESCRIPTION

In the following detailed description, reference is made to the accompanying drawings which form a part hereof, and in which is illustrated by way of illustration of specific example embodiments in which the present general inventive concept may be practiced. It is to be understood that other example embodiments may be utilized and structural or logical changes may be made without departing from the scope of the present general inventive concept. The following detailed description, therefore, is not to be taken in a limiting sense, and the scope of the present general inventive concept is defined by the appended claims.

Ink containers usable with image forming apparatuses supply ink to ink ejectors to be ejected onto a substrate such as a print medium. The ink may contain unwanted particles such as undesired pigments that fall out of suspension therein that may negatively impact the ink container, ink ejector and other in-line components of the image forming apparatuses such as filters. Such unwanted particles may result in costly repairs and/or degradation of images formed by the ink ejected onto the substrate and/or prevent the use of a variety of pigment-based inks. Thus, removal of unwanted particles in an ink container is beneficial.

FIG. **1** is a perspective view with a cutout partially illustrating an ink container mounted on a carriage of an image forming apparatus according to an example embodiment of the present general inventive concept. Referring to FIG. **1**, in an example, a plurality of ink containers **10***a* and **10***b* are removably mounted on a carriage **12** of an image forming apparatus **18**. The carriage **12** moves in a reciprocating motion d_r, for example, in a back and forth linear motion across a substrate **16** on which ink is intended to be ejected such as to form images. The substrate **16** may move in a feeding direction d_f substantially perpendicular to the reciprocating motion d_r. In the present example, the ink containers **10***a* and **10***b* are separate from the ink ejectors (not illustrated) such as print heads which, for example, may also be mounted on the carriage **12**. In other examples, the ink ejectors **69** (FIG. **7**A) may be integrated with the respective ink containers **10***a* and **10***b*. In the present example, the carriage **12** of FIG. **1** holds up to four ink containers. In other examples, the carriage **12** of FIG. **1** can hold more or less than four ink containers.

FIG. **2** is a block diagram illustrating an ink container according to an example embodiment of the present general inventive concept. Referring to FIGS. **1** and **2**, in an example, an ink container **20** includes a chamber **22** that may be configured to supply ink to the ink ejector of the image forming apparatus **18**. The ink container **20**, for example, may correspond to one of the ink containers **10***a* and **10***b* illustrated in FIG. **1**. The ink container **20** also includes a separation member **24** disposed within the chamber **22**. In the present example, the separation member **24** is configured to separate unwanted particles such as pigments that fall out of suspension from the ink in response to the reciprocating motion d_r of the carriage **12** and gravity, and to direct the ink downstream to the ink ejector. That is, the separation member **24** prevents unwanted particles from being supplied to the ink ejector. In the present example, the ink container **20** is usable with an image forming apparatus **18** having a carriage **12** to transport

the ink container **20** in a reciprocating motion d_r across a substrate **16** and an ink ejector to eject the ink onto the substrate **16**.

FIG. **3** is a perspective view illustrating the ink container of FIG. **2** according to an example embodiment of the present general inventive concept. Referring to FIG. **3**, in the present example, the separation member **24** includes side walls **31***a* and **31***b* extending downwardly. The side walls **31***a* and **31***b*, for example, are configured to form at least a portion of trenches **33***a* and **33***b* to collect the unwanted particles, respectively. As illustrated in FIG. **3**, a side wall **31***a* of the separation member **24** forms a side wall of the respective trench **33***a*. The separation member **24** also includes a ramp portion **35** disposed between the side walls **31***a* and **31***b*. The chamber **22** has a length l_c.

FIG. **4**A is a side view of the ink container of FIG. **3** illustrating an inclined ramp portion of a separation member according to an example embodiment of the present general inventive concept. Referring to FIGS. **1**, **3** and **4**A, the ramp portion **35** is configured to direct the unwanted particles to the respective trenches **33***a* and **33***b* in response to the reciprocating motion d_r of the carriage **12** and the gravity, and to direct the ink downstream to the ink ejector of the image forming apparatus **18**. As illustrated in FIG. **4**A, the ramp portion **35** is inclined and extends across an entire length l_c of the chamber **22** and descends in a downstream direction d_i of the chamber **22**. The ramp portion **35** forms an angle Θ_r with respect to a bottom surface of the chamber **22**. In the present example, Θ_r, may be in a range of 1 to 10 degrees. In another example, Θ_r may be less than 1 degree. In other examples, Θ_r may be greater than 10 degrees.

Referring to FIGS. **3** and **4**A, in the present example, the ramp portion **35** includes top portions **46***a* and **46***b* and a central portion **47**. Each top portion **46***a* and **46***b* is disposed at an intersection of the respective side wall **31***a* and **31***b* and the ramp portion **35**. The central portion **47** is disposed between the top portions **46***a* and **46***b* and is lower than the top portions **46***a* and **46***b*. As illustrated in FIGS. **3** and **4**A, the side walls **31***a* and **31***b* include wicking members **49** configured to transport the ink from the respective trenches **33***a* and **33***b* to the ramp portion **35**, for example, in an upward direction. The ink may move in an upward direction along the wicking members **49** through capillary forces. FIG. **40** is a cross-sectional view of a side wall of a separation member according to an example embodiment of the present general inventive concept. In the present example, the wicking members **49** may include grooved channels **49***a* and/or ribs **49***b* that extend along a respective height h_{sa} and h_{sb} of the side walls **31***a* and **31***b* as illustrated in FIGS. **3**-**4**B. In other examples, h_{sa} and h_{sb} may not be equal to each other.

FIG. **4**B is a top perspective view illustrating the ramp portion of FIG. **3** according to an example embodiment of the present general inventive concept. As illustrated in FIG. **4**B, in the present example, the wicking members **49** extend onto areas of the ramp portion **35** proximate to the respective top portions **46***a* and **46***b* thereof. Thus, the ink directed out of the trenches **33***a* and **33***b* onto the ramp portion **35** may be directed towards the central portion **47** of the ramp portion **35**. From the central portion **47** of the ramp portion **35**, the ink may be directed downstream d_i towards the ink ejector. As illustrated in FIG. **4**B, in the present example, the separation member **24** may also include a pair of bottom members **45***a* and **45***b* in which each bottom member **45***a* and **45***b* is configured to extend outwardly from a lower end of the respective side wall **31***a* and **31***b* to form a bottom portion of the respective trench **33***a* and **33***b* such that the trenches **33***a* and **33***b* are disposed adjacent to the ramp portion **35** and extend along the entire length of the chamber **22**. In other examples, the separation member **24** may not include a pair of bottom members **45***a* and **45***b* in which a portion of a bottom surface of the chamber **22** may form the bottom portion of the respective trench **33***a* and **33***b*.

FIG. **5** is a block diagram illustrating an ink container according to an example embodiment of the present general inventive concept. Referring to FIG. **5**, in the present example, an ink container **50** includes chambers **52** and **53** in fluid communication with each other. One chamber **52** is disposed upstream from an other chamber **53**. The one chamber **52** is configured to supply ink to the other chamber **53**. As illustrated in FIG. **5**, a separation member **54** is disposed within the one chamber **52**. In the present example, the separation member **54** of FIG. **5** may be similar to the separation member **24** described and illustrated in FIGS. **2**-**4**B. The separation member **54** illustrated in FIG. **5** is configured to separate unwanted particles from the ink in response to the reciprocating motion d_r of the carriage **12** (FIG. **1**) and gravity. In the present example, the ink container **50** may be usable with the carriage **12** of the image forming apparatus **18** to move the ink container **50** in the reciprocating motion d_r.

FIG. **6** is a perspective view illustrating the ink container of FIG. **5** according to an example embodiment of the present general inventive concept. Referring to FIG. **6**, in the present example, a wall **66** separates the one chamber **52** from the other chamber **53**. The wall **66** may include an opening **67** on a lower portion thereof to allow fluid communication between the one chamber **52** and the other chamber **53**. In an example, the other chamber **53** may include an ink ejector **69** (FIG. **7**A). In another example, the other chamber **53** includes a hole **68** (FIG. **7**B) leading to the ink ejector (not illustrated).

Referring to FIGS. **5** and **6**, the ink container **50** includes a separation member **54**, for example, that may be located proximate to a bottom portion of the one chamber **52**. Similar to the separation member **24** described and illustrated in FIGS. **2**-**4**B, the separation member **54** as illustrated in FIGS. **5**-**6**, in the present example, includes side walls **31***a* and **31***b* extending downwardly and the ramp portion **65**. The side walls **31***a* and **31***b* are configured to form at least a portion of the respective trenches **33***a* and **33***b* to collect the unwanted particles, respectively. The ramp portion **65** is disposed between the side walls **31***a* and **31***b* and inclined in a lengthwise direction l_r thereof. In an example, the ramp portion **65** includes a concave surface having a concavity extending across a width w_r of the ramp portion **65** (FIG. **8**). The ramp portion **35** is configured to direct the unwanted particles to the respective trenches **33***a* and **33***b* in response to the reciprocating motion d_r of the carriage **12** and to direct the ink through the opening **67** to the other chamber **53**.

Referring to FIGS. **6** and **8**, in the present example, the separation member **54** includes a pair of bottom members **45***a* and **45***b* as illustrated and described with respect to the separation member **24** of FIG. **4**B. Referring to FIGS. **6** and **8**, each bottom member **45***a* and **45***b* is configured to extend outwardly from a lower end of the respective side wall **31***a* and **31***b* to form a bottom portion of the respective trench **33***a* and **33***b*. In an example, the trenches **33***a* and **33***b* are disposed adjacent to the ramp portion **35** and extend along the entire length l_{cc} of the one chamber. In other examples, the separation member **54** may not include a pair of bottom members **45***a* and **45***b* and, thus, a portion of a bottom surface of the chamber **52** may form the bottom portion of the respective trench **33***a* and **33***b*.

As illustrated in FIGS. **6** and **8**, the side walls **31***a* and **31***b* include wicking members **49** configured to transport the ink from the respective trenches **33***a* and **33***b* to the ramp portion

65, for example, in an upward direction. The ink may move in an upward direction along the wicking members **49** through capillary forces. In the present example, as illustrated in FIGS. **4**C, **6**, and **8**, the wicking members **49** may include at least one of grooved channels **49***a* and ribs **49***b* that extend along a respective height h_{sa} and h_{sb} of the side walls **31***a* and **31***b*.

FIGS. **9**A and **9**B are top perspective views of a portion of ink container illustrating movement of the ink and unwanted particles in response to carriage motion according to example embodiments of the present general inventive concept. Referring to FIG. **9**A, in the present example, the carriage **12** in which the respective ink container **20** and **50** is attached is moving d_{car} to a right-side of the image forming apparatus **18** (FIG. **1**). Unwanted particles **95**, for example, drop out of suspension from the ink due to gravity and reside on the ramp portion **35** and **65**. The unwanted particles **95** residing on the ramp portion **35** move opposite to a direction of acceleration of the carriage **12** due to the carriage motion d_{car}. That is, when the acceleration direction of the carriage **12** is to the right-side of the image forming apparatus **18**, the unwanted particles residing on the ramp portion **35** move to a left-side of the image forming apparatus **18** due to kinetic energy caused by the carriage motion d_{car} and into the respective trench **33***a* due to gravity. The ink in the respective trench **33***a* moves out of the trench **33***a* towards the ramp portion **35** along the wicking members **49** due to capillary forces. The unwanted particles previously collected in the opposite trench **33***b* are prevented from escaping out of the respective trench **33***b* due to the respective side wall **31***b* acting as a barrier. The ink proximate to the ramp portion **35** and **65** moves downstream due to inclination of the ramp portion **35** and **65**.

Referring to FIG. **9**B, in the present example, the carriage **12** in which the respective ink container **20** and **50** is attached is moving d_{car} to the left-side of the image forming apparatus **18**. Unwanted particles **95**, for example, drop out of suspension from the ink due to gravity and reside on the ramp portion **35** and **65**. The unwanted particles **95** residing on the ramp portion **35** and **65** move opposite to the direction of acceleration of the carriage **12** due to the carriage motion d_{car}. That is, when the acceleration direction of the carriage **12** is to the left-side of the image forming apparatus **18**, the unwanted particles residing on the ramp portion **35** move to the right-side of the image forming apparatus **18** due to kinetic energy caused by the carriage motion d_{car} and into the respective trench **33***b* due to gravity. The ink in the respective trench **33***b* moves out of the trench **33***b* towards the ramp portion **35** along the wicking members **49** due to capillary forces. The unwanted particles previously collected in the opposite trench **33***a* are prevented from escaping out from the respective trench **33***b* due to the respective side wall **31***a* acting as a barrier. The ink proximate to the ramp portion **35** and **65** moves downstream, in part, due to inclination of the ramp portion **35** and **65**.

The present general inventive concept has been described using non-limiting detailed descriptions of example embodiments thereof that are provided by way of example and are not intended to limit the scope of the present general inventive concept. It should be understood that features and/or operations described with respect to one example embodiment may be used with other example embodiments and that not all example embodiments of the present general inventive concept have all of the features and/or operations illustrated in a particular figure or described with respect to one of the embodiments. Variations of example embodiments described will occur to persons of the art. Furthermore, the terms "comprise," "include," "have" and their conjugates, shall mean, when used in the disclosure and/or claims, "including but not necessarily limited to."

It is noted that some of the above described example embodiments may describe the best mode contemplated by the inventors and therefore may include structure, acts or details of structures and acts that may not be essential to the present general inventive concept and which are described as examples. Structure and acts described herein are replaceable by equivalents, which perform the same function, even if the structure or acts are different, as known in the art. Therefore, the scope of the present general inventive concept is limited only by the elements and limitations as used in the claims.

What is claimed is:

1. An ink container usable with an image forming apparatus having a carriage to transport the ink container in a reciprocating motion across a substrate and an ink ejector to eject the ink onto the substrate, the ink container comprising:

a chamber configured to supply ink to the ink ejector of the image forming apparatus; and

a separation member disposed within the chamber and including a plurality of side walls extending downwardly and a ramp portion disposed between the side walls, the separation member configured to separate unwanted particles from the ink in response to the reciprocating motion of the carriage and gravity, and to direct the ink downstream to the ink ejector;

the plurality of side walls configured to form at least a portion of trenches to collect the unwanted particles, respectively; and

the ramp portion configured to direct the unwanted particles to the respective trenches in response to the reciprocating motion of the carriage and the gravity, and to direct the ink downstream to the ink ejector of the image forming apparatus.

2. The ink container according to claim **1**, wherein the ramp portion is inclined and extends across an entire length of the chamber in a descending manner in a downstream direction.

3. The ink container according to claim **2**, wherein the ramp portion comprises:

a plurality of top portions, each top portion is disposed at an intersection of the respective side wall and the ramp portion; and

a central portion disposed between the plurality of top portions such that the central portion is lower than the plurality of top portions.

4. The ink container according to claim **3**, wherein the plurality of side walls comprises: a plurality of wicking members configured to transport the ink from the respective trenches to the ramp portion.

5. The ink container according to claim **4**, wherein the plurality of wicking members comprises:

at least one of grooved channels and ribs extending along a respective height of the plurality of side walls.

6. The ink container according to claim **5**, wherein the plurality of wicking members extends onto areas of the ramp portion proximate to the respective top portions thereof.

7. The ink container according to claim **6**, wherein the separation member further comprises:

a pair of bottom members, each bottom member configured to extend outwardly from a lower end of the respective side wall to form a bottom portion of the respective trench such that the trenches are disposed adjacent to the ramp portion and extend along the entire length of the chamber.

8. An ink container usable with a carriage of an image forming apparatus to move the ink container in a reciprocating motion, the ink container comprising:

a plurality of chambers in fluid communication with each other, one chamber is disposed upstream from an other chamber and is configured to supply ink to the other chamber; and

a separation member disposed within the one chamber proximate to a bottom portion thereof, the separation member including a ramp portion extending across a length of the chamber in an inclined and descending manner in a downstream direction; and

wherein the separation member is configured to separate unwanted particles from the ink in response to the reciprocating motion of the carriage and gravity.

9. The ink container according to claim 8, further comprising:

a wall separating the one chamber from the other chamber, the wall having an opening on a lower portion thereof to allow fluid communication between the one chamber and the other chamber; and

wherein the other chamber comprises an ink ejector.

10. The ink container according to claim 9, wherein the separation member comprises:

a plurality of side walls extending downwardly, the plurality of side walls configured to form at least a portion of trenches to collect the unwanted particles, respectively; and

the ramp portion disposed between the side walls and inclined in a lengthwise direction thereof, the ramp portion configured to direct the unwanted particles to the respective trenches in response to the reciprocating motion of the carriage and to direct the ink through the opening to the other chamber.

11. The ink container according to claim 10, wherein the plurality of side walls comprises:

a plurality of wicking members configured to transport the ink upwardly from the respective trenches to the ramp portion.

12. The ink container according to claim 11, wherein the plurality of wicking members comprises:

at least one of grooved channels and ribs extending along a respective height of the plurality of side walls.

13. The ink container according to claim 12, wherein the separation member further comprises:

a pair of bottom members, each bottom member configured to extend outwardly from a lower end of the respective side wall to form a bottom portion of the respective trench such that the trenches are disposed adjacent to the ramp portion and extend along the entire length of the one chamber.

14. The ink container according to claim 13, wherein the ramp portion further comprises:

a concave surface having a concavity extending across a width of the ramp portion.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO.	: 8,556,397 B2
APPLICATION NO.	: 13/259690
DATED	: October 15, 2013
INVENTOR(S)	: Jon Rittgers et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the Title Page, Item (73), Assignee, in column 1, line 2, delete "L. P.," and insert -- L.P., --, therefor.

Signed and Sealed this
Third Day of June, 2014

Michelle K. Lee

Michelle K. Lee
Deputy Director of the United States Patent and Trademark Office